Lord Howe Island, A Riddle of the Pacific, Part III

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IN THIS FINAL PART (for parts I and II see Pacif. Sci. 12 (1):82–91, 14 (1): 75–85) the author is dealing mainly with a review of the insects and with general conclusions.

INSECTA

Our knowledge of the insects of Lord Howe Island is only preliminary and incomplete. Some groups, for example butterflies and beetles, are more or less sufficiently studied, other groups very poorly.

Descriptions of new endemic species and records of the insects of the island are dispersed in many articles, and a summary of our knowledge in this regard is lacking. However, a high endemism of the fauna is evident. Although the degree of endemism is only at the specific, or at most the generic level, the connection with other faunas is very significant.

Olliff (1889) wrote an interesting review of Coleoptera of the island. In his time about 80 species of Coleoptera were recorded, but among them were 46 new species and 5 doubtfully new. That is, more than 56% were endemic species. Similar reviews for other groups are lacking.

An interesting large, wingless phasmid with a body length of 106 mm, *Dryococelus* (formerly *Carabidion*) *australis* Montr., is now probably extinct. Gurney (1947: 391) wrote: "The present status of *Dryococelus* is uncertain. A note in Ward's Natural Science Bulletin (vol. 8, No. 2, p. 11, 1935) indicated that the species is extinct, but I have been informed by John W. H. Rehn, of the Academy of Sciences of Philadelphia, that he has seen a recently published note suggesting that the species is maintaining itself."

During two visits to the island, in 1954 and 1955, the author failed to find the insect. An official enquiry was made recently to the Administration staff of the island, and the author received a letter from the Superintendent of the Island, Mr. H. Ward, on Nov. 3, 1961, in which he states: "A number of the old inhabitants have been questioned and all have advised that it is at least 30 years and possibly 40 years since this insect has been seen on the Island. A member of the staff, aged 33 years, has never seen or heard of the insect, nor has any pupil of the local School."

The only possibility is that the insect may still exist in one of the biggest banyan trees on the slope of Mt. Gower, on the lagoon side. The area is well isolated from the settlement where the rat concentration was probably the greatest, and may have survived in crevices of the tree.

The presence of the insect in the past is evidence of an ancient connection with Australia or some other continent by a land bridge; any other type of transportation is highly improbable.

A very interesting example of distribution is found in an archaic Homopterous family, the Peloridiidae, with very limited possibilities of movement (nearly wingless), and adapted to very restricted habitat. There are 15 species recorded now for the whole world. Thirteen of them are associated in Chile, New Zealand, Tasmania, and eastern Australia with the southern beech *Nothofagus*. The plant also grows in New Caledonia, and Dr. J. W. Evans (Director of the Australian Museum) visited this island especially to search for Peloridiidae. None were found, nor was an environment discovered which would be favourable for their existence.

In 1959 J. W. Evans, having been informed that a single nymph was recorded from Lord Howe Island, visited the summit of Mt. Gower

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FIG. 1. A typical cloud "carpet" covering the summit of Mt. Gower while the rest of the island is in sunshine. This "carpet" preserves the humidity and coolness over long periods, in strong contrast with other parts of the island. (Photo by Miss Z. Liepa.)

and during 3 hr *(sic)* found two new species of this family.

It is interesting to note that *Nothofagus* is absent from Lord Howe Island, but 24 adults and 7 nymphs of Peloridiidae were found in moss. Probably the Peloridiidae are not especially associated with *Nothofagus,* but require, above all, high humidity with cool temperatures. It is evident that this family has lived on the island in a very specialised habitat for millions of years. The possibility of transportation must be excluded. It means that the general conditions for life are unchanged: the summit of Mt. Gower is a refuge for species ecologically close to recent New Zealand fauna and flora (see Fig. 1), whereas at sea level are preserved elements from the north, from purely tropical areas.

It is noteworthy that, of the endemic palms, two dwarf species grow not at sea level, as do two others (see Fig. 2), but much higher up, closer to the summits of the two large mountains.

The submerged land "Howeania" was isolated from Australia, or connected only in the far north, and the present "Australian" elements we must regard as casual elements, not as having come by a direct land bridge. The Australian elements play an important role in the composition of the flora and fauna of the island, but it is remarkable that the most typical Australian forms, the Australian "sui generis," are absent.

The Diptera of the island have not been reviewed, the main obstacle being the lack of knowledge of the fauna of surrounding areas. The dipterofauna in general is very impoverished, because the island lacks fresh water basins, and the running streams are of temporary character. Therefore the families and

genera connected in their life history with water are absent. Sandy ecological niches are also poorly represented, and in general the ecological uniformity is a factor which limits the richness in flies.

However, many new species were discovered from the families Asilidae, Muscidae, Ortalidae, Leptidae, Calliphoridae, Tachinidae, etc. (see references).

The author has the impression, however, that most of the endemic species are represented in the surrounding areas by closely related species. Nothing extremely old or "extra" was found; however, only the lower part of the island has been comparatively studied. The middle zone (about 1,000 ft) and the high zone (2,000 ft and above) are practically untouched. The small fresh-water streams and pools deserve the special attention of collectors.

The author observed the hatching of enormous numbers of *Lucilia* and *Sarcophaga* from the sand on the beach. They emerged early in the morning, and with wings still undeveloped walked onto the small rocks on the shore, the surface of some of the rocks being absolutely covered with them. Here they waited until their wings were developed and then flew away. The sandy area is covered by sea during high tide, but the puparia apparently are not harmed. The author observed no hatching from the sandy areas not reached by the high tide.

To illustrate the state of our knowledge of the Lord Howe Island fauna we may quote the results of J. D. Bradley's collecting in 1953: in 1½ days of collecting, among 22 specimens of Microlepidoptera there were 12 species, 8 of which were new, and 4 others which were Australian species not previously recorded for the island.

The island is also very suitable for experiments in insect biological control. In October

FIG. 2. Two endemic species of palms which dominate the lower part of the island. Before the last war the export of their seeds was an important industry of the island. (Photo by Miss Z. Liepa.)

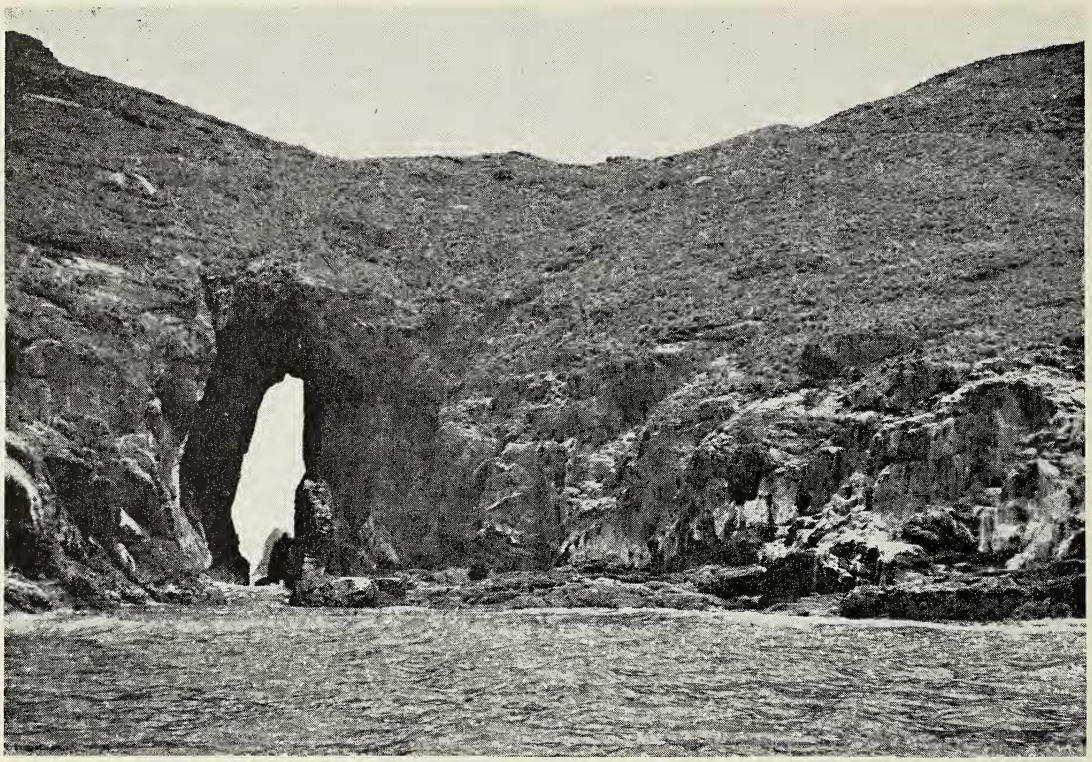


FIG. 3. An "Arcade" on Admiralty Island. The greyish dots in the air are sea birds which nest there. The basalts form the main mass of the island. (Photo by Miss Z. Liepa.)

1959, specimens of *Opius oophilus* were liberated there to control the Queensland fruit fly, *Strumeta tryoni,* and the parasite was recovered in March 1961. The small size of the island greatly facilitated the experiments.

It is impossible to go into details about the insect fauna of the island as the available data are too fragmentary. However, some points are very significant, especially those concerning wingless insects (and birds); they show a close relationship to the New Zealand fauna and to the eastward land masses in general. The Australian element, considered numerically, may be larger than that of New Zealand or Polynesia, but the proximity of the Australian continent, its great extension northwards and southwards, and the direction of the prevailing winds in the southwest Pacific no doubt account for this preponderance. If we take as an example the plant genera which are confined to Australia and Lord Howe Island *(Notelaea, Melaleuca, Lyonsia, Lagunaria,* and *Westringia),* we must not overestimate the importance of this fact, because the most characteristic Australian genera are either entirely absent from Lord Howe Island or represented by only one or two species. This means that these species have had more facilities for transportation, natural or by man.

Summarizing all the data in our hands, we can say from its fauna that Lord Howe Island is not a part of the Australian zoogeographical region, but is closer to the New Zealand subregion.

GEOLOGY

In order to understand the history of the fauna and flora the geology also must be considered. The general geology of the island is very simple; the island consists mainly of two principal formations: the volcanic rock which

forms the general mass (see Fig. 3), and the stratified beds resting on it (see Fig. 4). Two thirds of the island is composed of volcanic rocks, comprising three isolated masses.

Edgeworth (1889: 132) summarized his study of rocks as follows:

1. All the igneous rocks of Lord Howe Island (so far as represented by the collection examined) belong to the Basalt group.
2. A vast period of time must have elapsed between the eruption of the diabasic basalt and that of comparatively recent olivine basalt.
3. All the basalts, with the exception of the diabasic types, are probably not earlier than Tertiary, and some may be Post-Tertiary.
4. The diabasic basalt is probably Pre-Tertiary, or may be Paleozoic.

Immediately overlaying the volcanic rocks, and between them and the succeeding coral-sand rock series, occurs a bed of stiff unctuous red or yellow clay. It does not appear to be fossiliferous.

More interesting is the coral-sand rock series; this deposit is often from 30 to 40 ft high. The coral-sand rock is the chief fossiliferous deposit of the island, and has yielded the remains of the interesting reptile *Meiolania,* eggs of turtles, bird-bones, and recent species of both land and marine shells.

A systematic boring of this deposit, as well as of coral beds in the sea, may give us a detailed picture of the island's physical history. Unfortunately, geological study is only at a preliminary stage, and when it was stated that no minerals of economic value existed on the island further investigations were stopped.

The island deserves, however, our special attention as a very convenient object where the history of Australia, of the surrounding areas to the east, and of the Pacific may be studied much more easily than at other points.

The impoverished fauna and flora and the simple geological structure may give us all

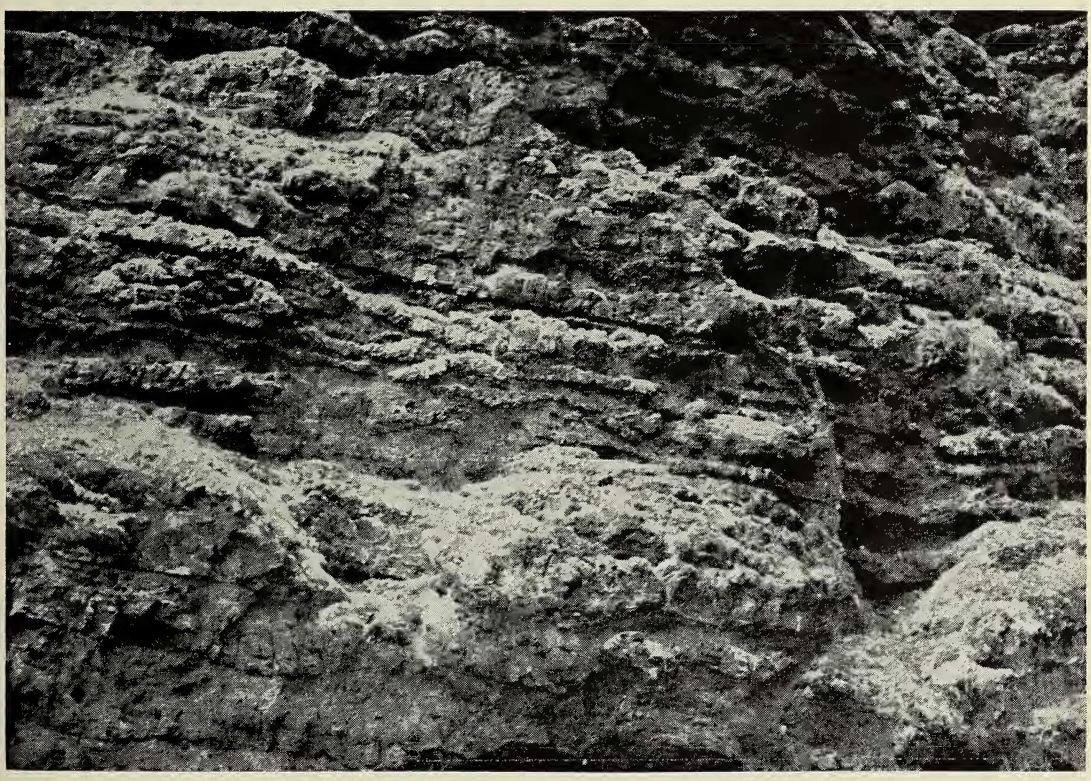


FIG. 4. A typical stratified deposit at the eastern seashore east of Old Gulch; the coral-sand strata are prominent. (Photo by Miss Z. Liepa.)

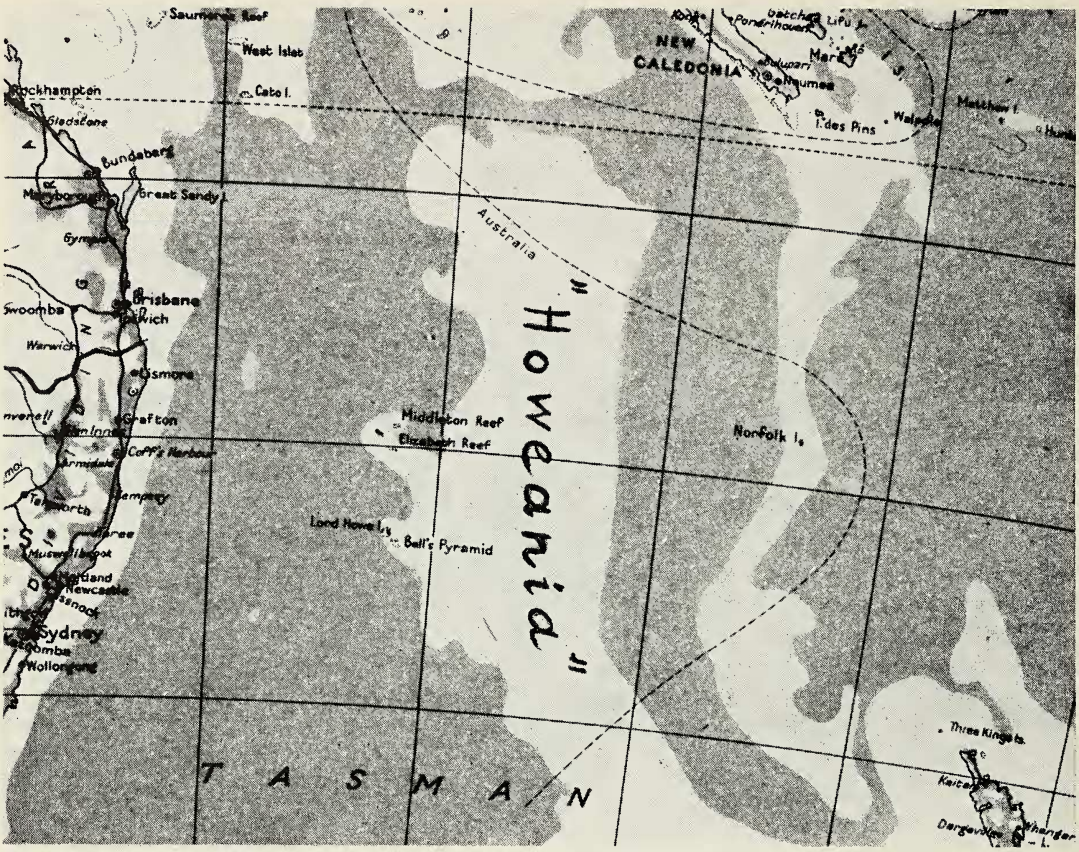


FIG. 5. Map showing the area of "Howeania."

the necessary data, because of the small volume of material for study. Lord Howe Island may be the focal point for the study of this area of the Pacific.

An enormous number of facts about the Australian continent remain to be studied, and this will require many years of work, but the general outline of the history of organisms and environment may be elucidated much more rapidly if we know the history of Lord Howe Island. For developing synthetic conclusions the island represents an extremely useful area.

COMPOSITION OF THE FAUNA AND FLORA

The fauna and flora of the island probably consists of three different layers of animals and plants:

1. The remnant from the very large land mass, now submerged, which we have called "Howeania." This remnant is the oldest part of the fauna and flora.

2. Immigrants from surrounding areas, arriving after the land was submerged, i. e., very long ago, in the geological sense. These elements have had time to develop into new species.

3. Recent immigrants, helped directly or indirectly by man. We have some data which indicate that in recent time several species arrived on the island, but finding conditions unsuitable for permanent settlement they disappeared.

The history of the fauna can be illustrated with the help of Figure 5. If we suppose that the shallow area of the sea, shown by the white area, was the outline of the submerged land

(Howeania), then the peculiarities of the fauna and flora of the island can be explained easily.

The absence of typical Australian elements was caused by the very wide and deep part of the sea in between, which acted as an impassable barrier.

The presence of Australian elements which are not typical for the Australian fauna can be explained by the very narrow strait in the north (see dotted line of Tropic). It permitted the penetration of tropical elements, whilst the elements more adapted to moderate climate could reach the island from the south, where there was a broad land connection with New Zealand.

The very essential difference between the faunas of Lord Howe and Norfolk Island may be explained by the very large and deep sea area extending eastwards from Howeania. Since it is about halfway between New Caledonia and New Zealand and was connected to them by land, Norfolk Island contains elements of both countries.

The New Zealand elements are not represented so well on Lord Howe Island because the ecological conditions are very limited spatially, and they are confined mostly to the mountain summits of the island.

We have reached all these conclusions after attentive study of the animals and plants, details of which can not be demonstrated in a work of this size. The author reached these conclusions before consultation of the above map showed the distribution of the deep and the shallow portions of the sea. The illustrated structure of the sea bottom fully supports the author's considerations, which are not purely theoretical speculations based on the study of biology, but reflect also the history of the land masses in the discussed area. Here we have a working theory for reconstruction of the history of the island and its life. The theory also explains satisfactorily the history of the basic part of the island's fauna.

With regard to the immigrants which reached the island after the submergence of Howeania, the position is less satisfactory: first, there is a lack of data about the fauna of the island; second, data are lacking about the distribution of organisms in the surrounding areas. Without these data, reconstruction of the history of the fauna and flora is impossible.

Regarding comparatively recent immigrants, we must consider the role of man in the distribution of plants and animals. Early whalers must have played a considerable part. If, for example, we find on the island a plant which has a strange, widely interrupted distribution, such as South Africa and the island, and grows near the sea shores, we have grounds to suspect that the plant has been transported by ships. As an example, we may cite the case of the so-called "African water lily" in Australia (*Aponogeton distachyum,* or Cape Pond Lily). The author found the lily in 1947 in the lagoon at Lorne, Victoria. This plant is very abundant there, and in July the entire lagoon is covered with the white flowers. The lily is rapidly diminishing in numbers, however, and we must predict that sooner or later it will disappear from the lagoon.

During the last century whalers introduced many animals and plants along the sea shores which they visited. One of the island's chief industries began in this fashion, i. e., the culture of the high quality onion, some bulbs of which had been washed ashore, found by an island woman, and planted.

COMPOSITION OF THE FLORA

Oliver (1917) gave an analysis of the composition of the island's flora. Although the data are outdated in nomenclature, the conclusions may be regarded as valid.

Of the 169 genera of vascular plants represented on Lord Howe Island 4 are endemic. Of these 4 genera, *Colmeiroa* and *Hedyscepe* are allied to New Zealand forms, *Negria* to both New Zealand and New Caledonian genera, and *Howea* to Malayan and tropical Australian genera.

If the five species belonging to these 4 genera be taken as modified descendants of species which arrived via a land bridge, then they would indicate a New Caledonia–New Zealand migration, with the land connection severed first at the southern end, thus accounting for a greater degree of peculiarity for the species related to New Zealand forms.

Of the nonendemic genera 95 are widely distributed, occurring in New Zealand, Australia, and Polynesia; 47 others range widely through tropical countries, but do not reach New Zealand; 1 occurs in New Zealand only; 5 in Australia only; 3 in Polynesia only; 11 in New Zealand and Australia only; 2 in New Zealand and Polynesia only; 1 in Africa only.

It is interesting to state, and Oliver omitted to do so, that most of the genera are represented only by a few species: 169 genera are represented by 209 species, which means that speciation is not strong on the island. Progressive evolution was almost absent on the island, and we have only transformation, probably due to genetic impoverishment in the populations.

It is possible also that some endemics of the island are only relics of species more widely distributed in the past, and now preserved only on the island.

If we compare the number of the very widely distributed genera (see above) and the genera with very restricted areas, we see a great difference: of 165 nonendemic genera 95 are distributed in New Zealand, Australia, and Polynesia; 47 only in Australia and Polynesia; and only 23 belong to the different countries, but are isolated.

The presence of a large portion of widely distributed genera and species might have been expected in the flora of an isolated island, because species possessing facilities for wide dispersal would naturally form the bulk of immigrants after the land connection had been severed.

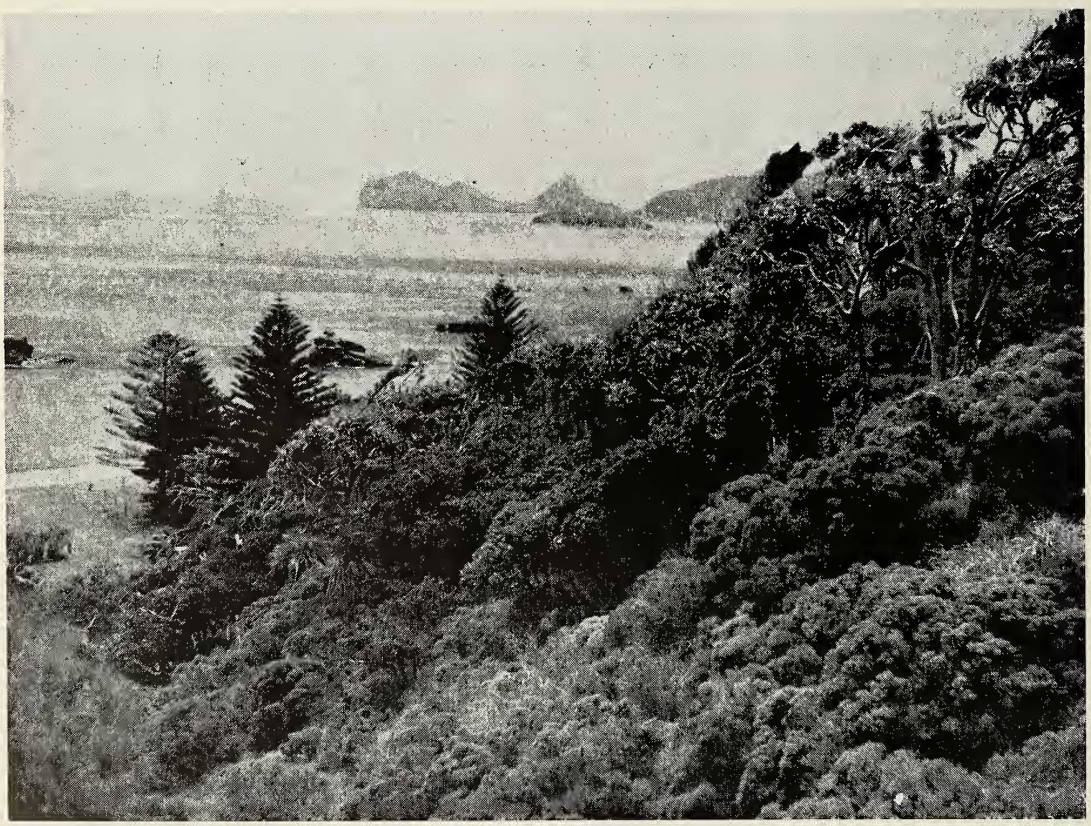


FIG. 6. View of the lagoon from the south; in the background are Rabbit Island and Mt. Eliza; on the seashore are three Araucarias introduced from Norfolk Island, growing well among the native plants. Taken at low tide. (Photo by Miss Z. Liepa.)

FIG. 7. The lagoon viewed from the south during low tide. In the foreground are coral reefs, of interest to the marine zoologist; behind these is low Rabbit Island, and in the background is the northern part of the island with tooth-shaped Mt. Eliza. (Photo by Miss Z. Liepa.)

This means that we must be very careful in making conclusions based only on numerical data. For the history of the flora and fauna the easily distributed elements are practically valueless.

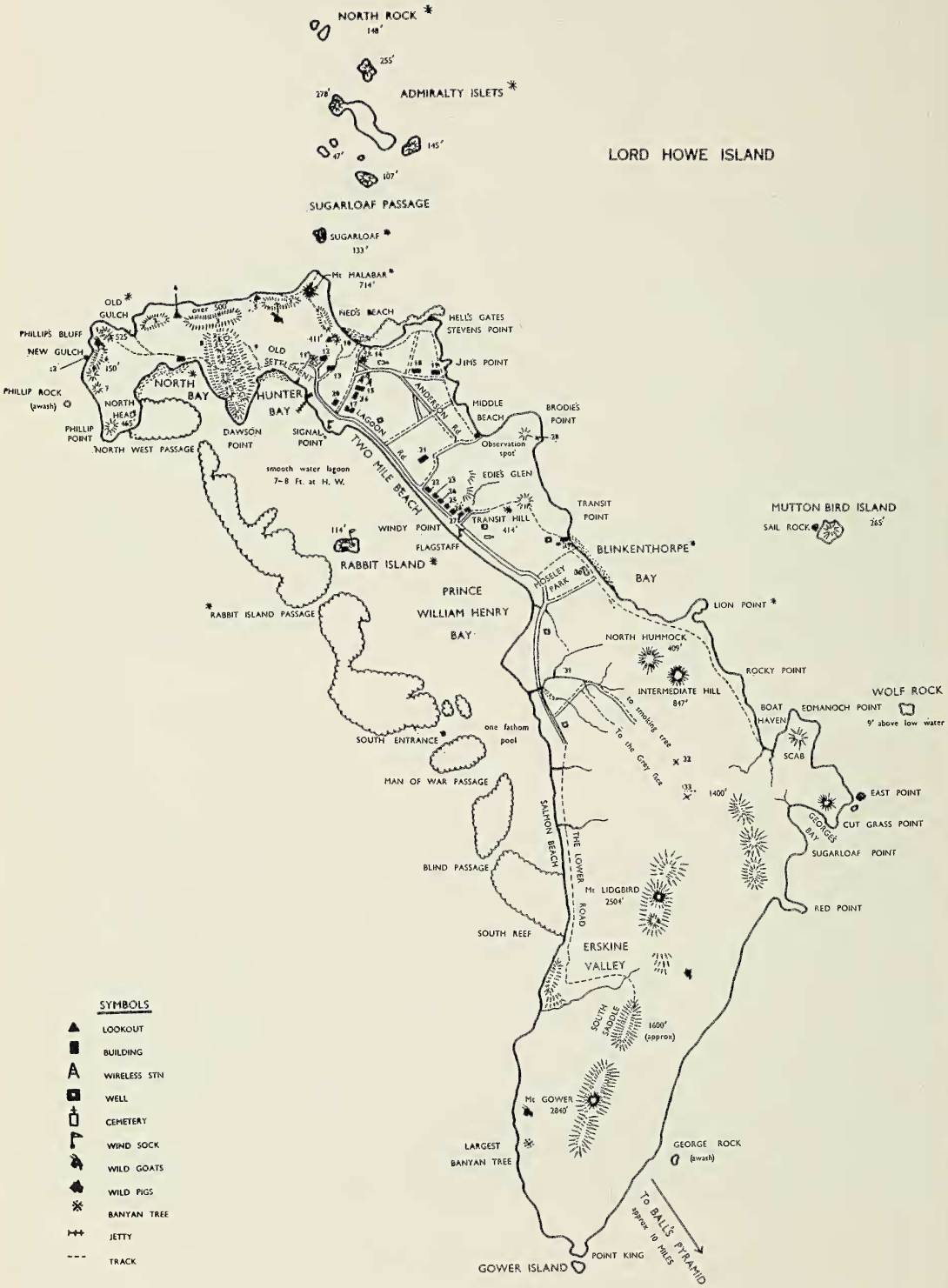
Let us turn to the analysis of the species. Of 209 species of the flora 70 (or 33%) are endemic. The percentage of specific endemism is very high. Oliver gives the following table which is very instructive:

TABLE 1

	TOTAL NO. OF SPECIES	ENDEMIC SPECIES INCLUDED IN TOTAL	PERCENTAGE OF ENDEMIC FORMS
Whole flora	209	70	33
Australia	168	41	24
New Zealand	109	38	35
Polynesia	116	39	34

From Table 1 (from Oliver, 1917) it is evident that endemic forms of Lord Howe Island are distinctly more closely related to New Zealand and Polynesia than to Australia. As a result, the line of Gressitt (1956) must be transferred westwards of Lord Howe Island, separating it from the Australian continent. The zoological data also have shown that the fauna of the island is more closely related to the lands to the east than to Australia.

A direct connection of Lord Howe Island with Norfolk Island, however, is doubtful, because the Araucarias of Norfolk Island have not reached Lord Howe Island naturally, although those transplanted by man are growing very well (see Fig. 6).


LORD HOWE ISLAND
NORTH ROCK
148'
255'
ADMIRALTY ISLETS
278'
145'
47'
107'
SUGARLOAF PASSAGE
SUGARLOAF
133'
Mt HALABAR
714'
OLD GULCH
over 500'
PHILLIPS BLUFF
525'
NEW GULCH
150'
PHILLIP ROCK
(awash)
NORTH BAY
NORTH HEAD
465'
PHILLIP POINT
NORTH WEST PASSAGE
OLD SETTLEMENT
HUNTER BAY
DAWSON POINT
SIGNAL POINT
LAGOON
RED'S BEACH
411'
HELL'S GATES
STEVENS POINT
JIMS POINT
ANDERSON RD
MIDDLE BEACH
BRODIES POINT
Observation spot
TWO MILE BEACH RD
smooth water lagoon
7–8 Ft. at H. W.
EDIES GLEN
TRANSIT HILL
414'
TRANSIT POINT
WINDY POINT
114'
FLAGSTAFF
RABBIT ISLAND
RABBIT ISLAND PASSAGE
PRINCE WILLIAM HENRY BAY
HOSELEY PARK
BLINKENTHORPE BAY
MUTTON BIRD ISLAND
SAIL ROCK
365'
LION POINT
NORTH HUMMOCK
409'
ROCKY POINT
INTERMEDIATE HILL
847'
WOLF ROCK
9' above low water
BOAT HAVEN
EDMANOCH POINT
SCAB
to smoking tree
To the Grey face
SOUTH ENTRANCE
one fathom pool
MAN OF WAR PASSAGE
1400'
EAST POINT
CUT GRASS POINT
GEORGES BAY
SUGARLOAF POINT
SALMON BEACH
THE LOWER ROAD
BLIND PASSAGE
Mt LIDGBIRD
2504'
RED POINT
SOUTH REEF
ERSKINE VALLEY
SOUTH SADDLE
1600'
(approx)
Mt GOWER
2840'
LARGEST BANYAN TREE
GEORGE ROCK
(awash)
To BALL'S PYRAMID
approx 10 MILES
POINT KING
GOWER ISLAND
SYMBOLS
LOOKOUT
BUILDING
WIRELESS STN
WELL
CEMETERY
WIND SOCK
WILD GOATS
WILD PIGS
BANYAN TREE
JETTY
TRACK

CONCLUSIONS

1. Lord Howe Island is not an "oceanic" island owing its existence to the activity of corals, although some part was played by them; the island's fauna and flora are not a casual "mixtum compositum" of elements arrived by various methods from different directions, during different epochs.

2. Lord Howe Island is a small part of a sunken continent or large island, preserving a very specific fauna and flora, with very high endemism (in some groups as high as 70%).

3. Some endemic species developed here probably as a result of very long isolation from the closely related population in the surrounding areas; other endemic species (some birds) probably are unchanged species preserved from the sunken land, being mostly destroyed by man in the surrounding areas.

4. The sunken land ("Howeania") was never connected with the Australian continent after creation of Eucalyptus and Acacia species, because on the island they are absent, although growing very well when introduced. It appears that the island's isolation is very old.

5. Lord Howe Island was probably never directly connected with Norfolk Island. The Araucarias of Norfolk Island, so typical of that island, are absent from Lord Howe Island. The species common to both islands are probably species with very strong capacity for dissemination.

6. Having no land connection with Australia and Norfolk Island, Lord Howe Island received its fauna and flora mostly from the north and south. Warmth-loving elements of the flora and fauna probably arrived from the northeast (palms, for example). All the tropical elements show a connection with this direction.

7. The elements of subtropical or moderate areas, liking cool climate and high humidity, probably arrived from southeastern and southern directions (the so-called New Zealand elements have their origin in these sectors).

8. Since it is a highly elevated island (up to 2,800 ft) Lord Howe Island has preserved its character, and its flora and fauna, for a long period of geological time. The flora and fauna of its summits (for example the plant *Dixonia*

FIG. 8.

1. Mt. Eliza
2. Caves in this area
3. North Hills
4. Dawson Peak
5. Poole's Lookout
6. North Ridge
7. Grassy Hill
8. North Scab
9. Old Settlement Creek
10. Thomson's Lookout
11. Settlement Creek
12. Hine's Curio Shop
13. "Ocean View" Guest House
14. The Peg
15. "Somerset" Guest House
16. Thomson's General Store
17. Electric Power Station
18. "Waverley's" Tea Rooms
19. "Dignam's" Tea Rooms
20. The Hall
21. "Leanda Lei" Hotel
22. Doctor
23. Post Office & Bank Agency
24. Hospital
25. Government House
26. School
27. "Pine Trees" Guest House
28. Nichol's Clear Place
29. Blinky Beach Picnic Hut
30. Lagoon
31. Soldier's or Big Creek
32. "Smoking Tree"
33. "Goat House"

Asterisks indicate localities known by more than one name. Those currently used on the island are shown on the map and alternative names are listed below:

Admiralty Islets: Roach Islets
Blinkenthorpe Bay: Ross Bay
Lion Point: Mutton Bird Point
Mt. Malabar: North Peak
North Bay: Callam's Bay
North Rock: North Islet
Old Gulch: Collin's Cove
Rabbit Island: Blackburn or Goat Island
Rabbit Island Passage: Boat Passage
South Entrance: Erscott's Passage
Sugarloaf: Soldier's Cap
Transit Hill: Lookout Mountain

antarctica, and the Peloridiidae insects) are very old elements, preserved in a nearly unchanged condition for many millions of years. It is evident that after the ancient land sank, there was no re-elevation of it which deserves serious attention (there were only slight oscillations of ocean).

9. At the present stage of our knowledge of the geology, paleontology, and biology of the island, it is impossible to draw any conclusions concerning the theory of drifting continents: there are no positive and no negative data.

10. Finding of interesting data can be expected after a study of Ball's Pyramid. This colossal rock has never been touched by exploration, and no specimens either of plants or of animals have been collected there. The possibility is not excluded that some forms which have been destroyed on the island may have survived on this rock.

11. There are numerous caves on the island, some very long, which have not been explored; we have reason to think that interesting remains of recent and past fauna may be preserved there.

12. The presence of a coral reef gives an opportunity to gather additional data about oscillations of the sea level, and their magnitude (see Fig. 7).

13. The preliminary data at our disposal give evidence that in the past there existed a large land mass, probably southeastward from Lord Howe Island, where the flora and fauna of the island developed. On the island itself we can find only remnants of this life of the past.

14. Lord Howe Island is a particularly interesting subject for the study of the Pacific and surrounding countries. The scientific value of the island has been underestimated, almost neglected. Only one expedition, organised by the Australian Museum in 1887, has worked on the island. Since then any study that has been done has been private, and by amateurs.

This article shows that the island deserves more serious attention: its interest is not local but international. Only longer expeditions of geologists and biologists, working together, can supply us with the necessary data.

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